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Root hairs increase rhizosphere extension and carbon input to soil

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Abstract

© The Author(s) 2017. Published by Oxford University Press on behalf of the Annals of Botany Company. All rights reserved. Background and Aims Although it is commonly accepted that root exudation enhances plant-microbial interactions in the rhizosphere, experimental data on the spatial distribution of exudates are scarce. Our hypothesis was that root hairs exude organic substances to enlarge the rhizosphere farther from the root surface. Methods Barley (Hordeum vulgare 'Pallas' - wild type) and its root-hairless mutant (brb) were grown in rhizoboxes and labelled with 14CO2. A filter paper was placed on the soil surface to capture, image and quantify root exudates. Key Results Plants with root hairs allocated more carbon (C) to roots (wild type: 13 %; brb: 8 % of assimilated 14C) and to rhizosheaths (wild type: 1.2 %; brb: 0.2 %), while hairless plants allocated more C to shoots (wild type: 65 %; brb: 75 %). Root hairs increased the radial rhizosphere extension three-fold, from 0.5 to 1.5 mm. Total exudation on filter paper was three times greater for wild type plants compared to the hairless mutant. Conclusion Root hairs increase exudation and spatial rhizosphere extension, which probably enhance rhizosphere interactions and nutrient cycling in larger soil volumes. Root hairs may therefore be beneficial to plants under nutrient-limiting conditions. The greater C allocation below ground in the presence of root hairs may additionally foster C sequestration.

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Keywords

14C imaging, Barley (Hordeum vulgare L.), Carbon allocation, Rhizosphere extension, Root exudates, Root hairs, Root-soil interface

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